FINNISH METEOROLOGICAL INSTITUTE

1|09

“Efficient services benefiting people and the environment are anchored in reliable observations and first-rate research.

Editorial

The Finnish Meteorological Institute

is for society and people


Antonin Halas

There has always been social demand for research and services associated with the weather and climate, and today this demand is greater than ever before. The Finnish Meteorological Institute is grounded in this demand.

Our climate change expertise is utilised for the information needs of State administration, the Government and ministries. Examples include the development of Finland's climate and energy policy, the drafting of the Government foresight report, and the leadership of the national IPCC activities. The Institute's know-how in the sectors of climate change and extreme weather phenomena is also useful in Finland's development cooperation policy. Moreover, private companies utilise our competence ever more widely.

The Finnish Meteorological Institute is constantly developing its round-the-clock weather warning and safety services. Our preparedness to provide first-rate services in all circumstances keeps improving. The supply of products enhancing public safety is also being expanded on our website, which – according to the measurements and surveys conducted – is both highly popular and highly valued by users.

In 2008, the Finnish Parliament decided to expand the Institute's field of operations to encompass physical marine research and sea-related services. Spurred by the growth of marine traffic in the Baltic Sea, demand for increasingly varied marine safety services is rising. New services to prepare for marine and rain floods are also developed as part of the warning system for monitoring natural disasters. The economic and political importance of the Arctic region is rising; this increases the need for research and services. There is also growing demand for marine and atmospheric expertise among enterprises in Finland. The melting of sea ice and Greenland's ice sheet will have a major impact on the climate, ocean currents and sea level. The Finnish Meteorological Institute will also address these challenges with vigour in the coming years.

The Finnish Meteorological Institute no longer publishes a conventional annual report. We will describe the work we do for the benefit of society and people in a journal-type review that comes out twice a year. The first issue is now in your hands.

Looking forward to continued cooperation,

Petteri Taalas
Director General

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Head of Unit Jouni Pulliainen (right) and Project Manager Kari Luojus explain that global thinning of the snow cover is one indicator of climate change.

The snow database improves

the accuracy of climate models

In the future, information of the snow cover transmitted by satellites can improve the accuracy of climate scenarios drawn up using climate models. The project coordinated by the Finnish Meteorological Institute will create a global snow databank.

"The snow cover has an impact on the local and global climate, for instance, through the reflection of light from the Earth's surface, the circulation of water, and the regulation of thermal balance on the Earth's surface," says **Jouni Pulliainen**, Research Professor and Head of the Arctic Research unit, when describing the importance of snow. "It's been discovered that the snow cover has diminished globally; this is one indicator of climate change."

The GlobSnow project financed by ESA will collect a global historical time series of satellite data that will be used to determine the prevalence, volume and physical state of the snow cover.

"The data collected in the databank will go back at least 15 years, and for some satellites 30 years. The project will also include an system constructed to produce snow data generated from satellite and ground observations for the needs of other users. The operational snow data are also saved as part of the historical time series," says Project Manager **Kari Luojus**.

The databank offers increasingly accurate input data for climate models, thereby improving the quality and accuracy of climate models even further. Operational snow monitoring is also an essential element of meteorological and hydrological modelling, management of the water and energy economy, and prediction of natural disasters.

The project utilises data collected by both European (ESA and EUMETSAT) and American satellites. Other participants come from Canada, Austria, Switzerland and Norway.

The Finnish Meteorological Institute conducts cutting-edge research and development in focal areas meeting society's needs. These are: weather and safety; climate change and its social impacts; the environment and health; earth observation and space; and the changing Baltic Sea.

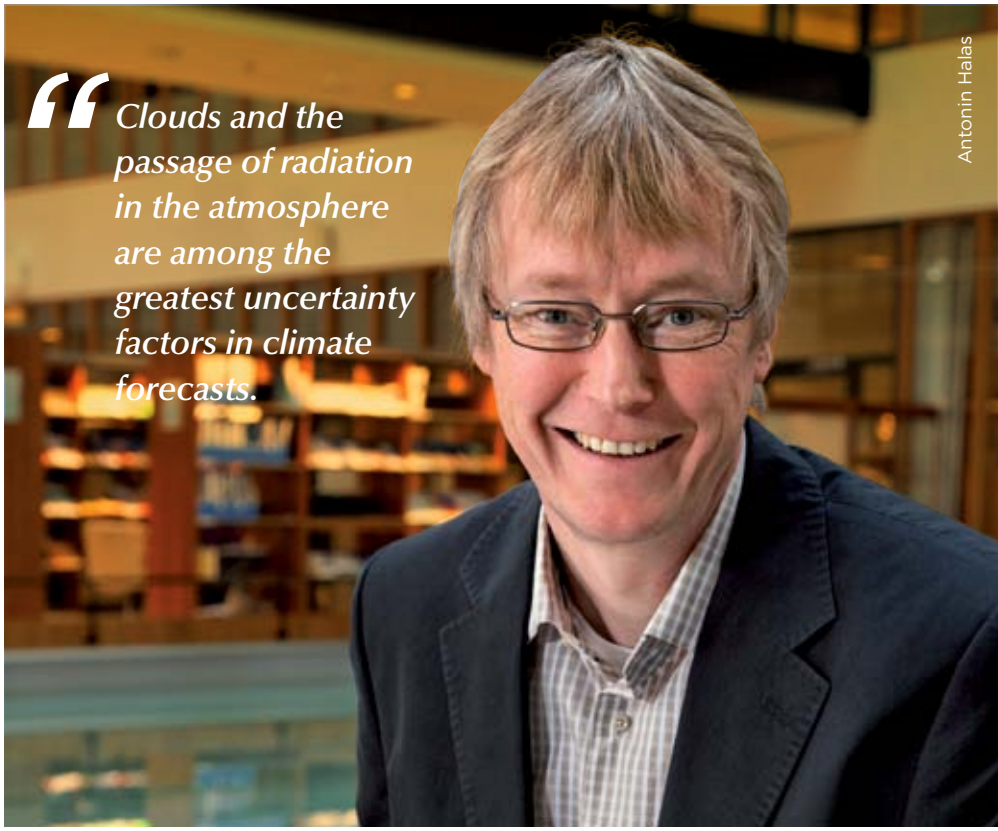
A new method

improves cloud modelling in climate and weather forecasts

A new way to model clouds reduces uncertainties associated with cloud modelling. The European Centre for Medium-Range Weather Forecasts (ECMWF) has also taken the method into use in its own forecasting system.

One common challenge in climate models is that clouds are typically much smaller in size than the grid square used in climate models. Clouds have usually been calculated by using the mean values of grid square variables, such as temperature or humidity. The new method can describe the features of cloudiness that are smaller than the gird square by using a stochastic, or partly random, approach.

The first tests on the stochastic modelling of clouds at grid square level were successful. "Contrary to advance expectations, the transformations tested had relatively little effect on the simulated climate. We had expected a greater effect," says Senior Researcher **Petri Räisänen**. "However, the result shows that the new cloud modelling method can safely be included in interlinked climate models, and that we can start to utilise the advantages of the new model in practice."



Research Professor Heikki Järvinen is developing a new method for cloud modelling.

Important to know the impact of clouds

"Clouds have a major impact on the climate. Correct modelling of clouds is crucial for the accuracy of climate models that explore climate change and its impacts," Research Professor **Heikki Järvinen** explains. "Clouds and the passage of radiation in the atmosphere are among the greatest uncertainty factors in climate forecasts."

"Clouds absorb thermal radiation from the ground and thus reduce the amount of thermal radiation escaping into space. On the other hand, they reflect the Sun's short-wave radiation away from the Earth," Heikki Järvinen says, describing the complex impact of clouds on climate change. "So far clouds cool the Earth. However, changes in the global climate will affect the impact of clouds on the climate," Heikki Järvinen says.

High-capacity computation was performed using the distributed European supercomputing environment and the computing resources of the Deisa infrastructure. The Finnish partner in the project is CSC – IT Center for Science Ltd.

The risks of extreme climate changes under investigation

Human-induced global warming may launch great, or 'extreme' climate changes. Researchers at the Finnish Meteorological Institute and the University of Helsinki have compiled a report on the topic for the Government.

So far, studies on the impacts of climate change have usually focused on warming that is assumed to proceed gradually and without major surprises. However, global warming also involves the possibility of extreme climate changes that come in spurts.

"The risk of extreme climate changes increases in step with the warming of the environment. This is another reason to restrict global warming as much as possible," says **Natalia Pimenoff**, who works as a researcher at the Finnish Meteorological Institute and was one of the authors of the report.

Climate change may progress in spurts

In non-linear climate change, the climate system moves over a threshold value – a turning point. Exceeding this turning point starts an irrevocable change that is stronger than the external constraints. Estimating the impacts of non-linear and extreme climate changes is difficult and involves many uncertainties.

According to the present understanding, the ice cover on the Arctic Ocean may disappear for the summer months already within the next few decades; the reason for this is global warming and the feedback mechanisms reinforcing it. Experts estimate that the ice sheet over Greenland may start to melt irreversibly if the global mean temperature rises 1–2 degrees from the present.

Thermohaline circulation in the North Atlantic is expected to weaken during this century. However, it is considered unlikely that the circulation would come to a halt. A weaker circulation will slow down warming in the North Atlantic region but won't stop it. There is also the risk that, within this century, global warming will melt much of the permafrost located near the surface.

Antti Samuli

The Finnish Meteorological Institute's measuring device probes Mars

The instrument provided by the Finnish Meteorological Institute for the Phoenix lander has been measuring atmospheric pressure on Mars. The observations help simulate the workings of the Martian atmosphere.

The Phoenix Mars spacecraft of NASA landed on the northern hemisphere of Mars in May 2008. The spacecraft carried an instrument for measuring atmospheric pressure designed by the Finnish Meteorological Institute. "The device has produced a series of observations on daily and seasonal changes in the Martian atmosphere and on daily weather phenomena that covers a period of about six months. The pressure instrument has been sensitive enough even to detect the dust whirls typical on Mars," says Group Leader **Ari-Matti Harri**.

A weather forecast for Mars

A researcher group at the Finnish Meteorological Institute, together with researchers at the University of Helsinki, analyses the observations made by the device. An important tool in this work is the MLAM weather model used to simulate activities in the Martian atmosphere. MLAM is a Martian version of the HIRLAM weather prediction model used in the Finnish Meteorological Institute.

"This is possible because the atmospheres of Mars and the Earth function in the same way, although the Martian atmosphere is simple compared to that of the Earth. By studying Mars, we gain new information on the Earth's atmosphere, information that is hidden by the complexity of our atmosphere. The success of Phoenix in its observation work is a highly important step for planetary and atmospheric research in general," Ari-Matti Harri says.

Knowledge of the Martian atmosphere improves our understanding of the development and evolution of atmospheres on all planets of our solar system, including our own planet. The observations made by Phoenix give more insight into the question of whether there has ever been conditions conducive to life on Mars.

Series of observations made by Digibaro-instrument

A series of observations of the Martian atmosphere made by the pressure instrument of the Finnish Meteorological Institute. The trace left by a dust whirl on the pressure signal is shown in a separate magnification window.

> *By studying Mars, we gain new information on the Earth's atmosphere, information that is hidden by the complexity of our atmosphere.*

A study on emissions

may help create a NOx Emission Control Area in the Baltic Sea

A study showed that nitrogen oxide emissions from marine traffic in the Baltic Sea were greater than had been estimated previously. Now HELCOM is preparing to apply for the status of a NOx Emission Control Area for the Baltic Sea.

"The ShipNODep project utilised observations on marine traffic to study the nitrogen oxide emission levels caused by shipping in the Baltic Sea. Estimates were based on the Automatic Information System data collected by countries on the Baltic Sea rim. These estimates were checked by comparing them against fuel consumption data provided by shipping companies and against air quality measurements in the vicinity of the navigation routes," says **Tapani Stipa** of the FMI Marine Research unit, who led the project.

The study showed that the total amount of emissions from shipping was greater than estimated before using other methods. Marine traffic in the Baltic Sea is the greatest single emission source; in some sea areas and at certain times of the year, it can give rise to as much as 50 per cent of the total airborne nitrogen oxide deposits. The total airborne nitrogen oxide deposits account for about 20–30 per cent of all nitrogen entering the Baltic Sea, and for as much as half of the total burden caused by man. They are therefore a major factor intensifying eutrophication in the Baltic Sea.

Emissions from shipping poorly known

For a long time, emissions from shipping were the least known of emissions caused by modes of transport. Up-to-date information on nitrogen oxide emissions caused by marine traffic in the Baltic Sea was lacking.

Hannu Manninen

So far no strict emission limits have been set for nitrogen oxides emitted by ships. A sufficient reduction of nitrogen oxides in view of the heavy eutrophication of the Baltic Sea can only be achieved by setting stringent restrictions. Spurred by the new research findings, the Baltic Marine Environment Protection Commission HELCOM has decided to apply for the status of a NOx Emission Control Area (NECA) for the Baltic Sea. The status is granted by the International Maritime Organization (IMO).

The project also made the first estimates of the deposits in the Baltic Sea caused by emissions and of their impacts on the Baltic Sea ecosystems. This was a joint effort by several bodies, including the Marine Research and Air Quality units of the FMI, the Marine Centre of the Finnish Environment Institute, the University of Turku, Åbo Akademi University, and the Estonian Ministry of the Environment.

> *"The study showed that the total amount of emissions from shipping was greater than estimated before using other methods.*

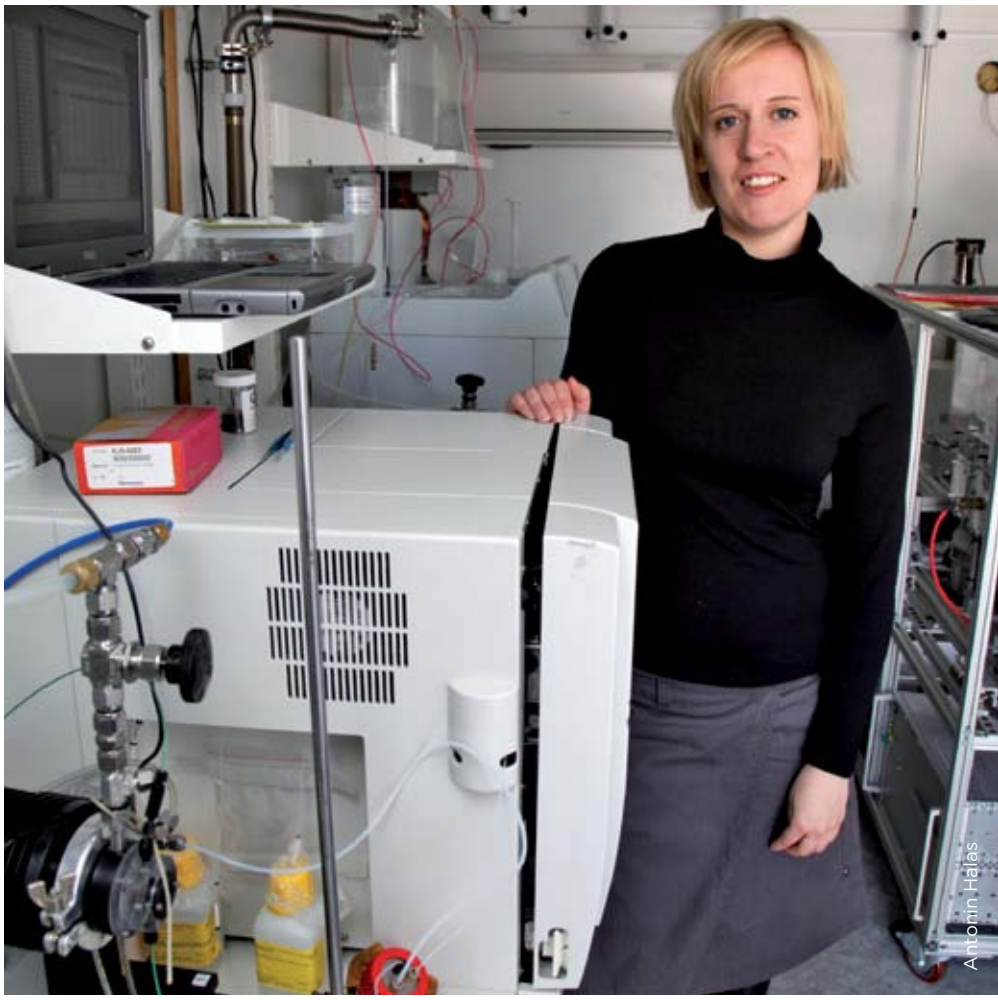
New measurements

give accurate information about particles in Helsinki

Transport and small-scale burning of wood give off the most hazardous fine particles in Helsinki in winter.

In her doctoral dissertation, researcher **Sanna Saarikoski** investigated the chemical properties and sources of atmospheric particles in various environments, at nine European measurement stations in six countries. The measurements showed that local and regional burning of wood was the biggest source of organic carbon in fine particles in Helsinki in winter. At other times, particles were mainly formed in the atmosphere by gaseous hydrocarbon compounds, or they were direct particle emissions from motor vehicles.

Since December 2008, it has been possible in Kumpula, Helsinki, to monitor the size and exact composition of fine particles at intervals of a few minutes. Measurements made using the efficient research equipment acquired jointly by the Finnish Meteorological Institute, the University of Helsinki and Helsingin Energia enable identification of pollution sources and evaluation of their health effects considerably more easily and more reliably than before.



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According to Researcher Sanna Saarikoski, the new research instruments give increasingly accurate information on fine particles in Helsinki.

Surprisingly rapid variation in the size and volume of particles

The first measurement period using the new equipment confirmed that the most hazardous fine particles in the winter air of Helsinki originate in transport, small-scale burning of wood, and energy generation in Finland's neighbouring areas.

"Transport and wood burning stand out among Helsinki's own sources of pollution. They may increase the concentrations of fine particles by a factor of 10 or 20, especially in situations where inversion keeps pollutants accumulated near the ground. The findings also show that air currents easily carry fine particles from Eastern and Central Europe to Finland," says Sanna Saarikoski, explaining the findings of her study.

The measurements indicate that both the concentration of particles and their volume and composition can vary markedly even within 24 hours. Moreover, fine particles may have very different compositions even on consecutive days. "The seemingly low concentrations of fine particles that often prevail in Helsinki may be misleading in terms of health effects if we are unable to determine the composition of particles," Saarikoski points out.

Researcher Annalea Lohila checking instruments at the Pallas measurement station of the Finnish Meteorological Institute.

Afforestation

may reduce carbon dioxide emissions from peat fields

Carbon dioxide emissions from grass-cultivated and afforested peatlands are smaller than those from a peat field that grows barley. The Finnish Meteorological Institute has studied carbon dioxide emissions from peatlands and the factors affecting them.

Information is needed on the climate impacts of various types of land use in peatlands so that we can draw up recommendations for land use types that slow down global warming.

Finland has more peatlands than any other European country. Draining of a bog by digging ditches lowers its water level; this accelerates the decomposition of carbon that has accumulated from the atmosphere into the bog over thousands of years. Peatlands turn from carbon sinks into carbon sources. Drained peatlands are major sources of carbon dioxide, therefore intensifying climate change.

"When carbon dioxide emissions from peatlands were investigated, it was discovered that grass-cultivated and afforested peatland released clearly less carbon dioxide into the atmosphere than a peat field growing barley. However, all the ecosystems studied acted as carbon sources," says **Annalea Lohila**, Researcher at the Finnish Meteorological Institute, summarising the findings.

More measurements needed

Few studies have investigated the effects of various types of land use on the greenhouse gas emissions of peatlands. The study conducted at the Finnish Meteorological Institute is the first where the carbon dioxide exchange of an entire forest stand was measured on afforested peatland.

"At present it seems that the gas balances of low-nutrient drained peatlands growing only wood have a cooling effect on the climate. The most dominant factor in the annual carbon dioxide balance is the length of the period when the ecosystem acts as a daily carbon dioxide sink. This period was the longest for afforested peatland and clearly the shortest for barley fields.

"However there is a great need for more reasearch. We are in the process of establishing a new site for carbon dioxide balance measurements on high-nutrient forest-drained peatland in Southern Finland. Because this type of land use covers a very large area in Finland and no corresponding measurements have been conducted previously on such peatland, we are waiting eagerly for the first results."

Finland's wind conditions to be collected on a map

Detailed information on wind conditions is important when new wind power projects are planned. The Finnish Meteorological Institutes is charting the wind conditions over Finland's sea and land areas to compile a Wind Atlas.

Finland is committed to raising the share of renewable energy to 38 per cent by the year 2020. This means that the use of all renewable energy sources must be increased. According to estimates, wind power could produce 10–30 per cent of the additional renewable energy needed.

"Detailed information on wind conditions is important when new wind power projects are planned. The Wind Atlas won't take a stand as to where wind power should be built. It will serve as a tool when suitable locations are sought for wind power parks," says Development Manager **Bengt Tammelin**.

Accurate data on winds

"The Wind Atlas will give as accurate a picture of wind conditions as possible: wind strength, direction and turbulence at different altitudes up to 400 metres," Bengt Tammelin explains.

Modelling is done using grid squares of 2.5 x 2.5 kilometres. In coastal regions and in other windy areas, the accuracy is even greater. Wind conditions are modelled by means of a numerical weather forecasting model, and the results are checked using measurements. Computer models are based on historical data on wind conditions.

The completed Wind Atlas will be published on the Internet late in 2009. Through the web interface, wind data can be examined together with geographical data and variables. Wind data can also be downloaded and transferred to other web services with the help of the WMS protocol. The Wind Atlas project will be completed in November 2009. It is funded by the Ministry of Employment and the Economy and coordinated by Motiva Oy.

> *"The Wind Atlas will serve as a tool when suitable locations are sought for wind power parks.*

Shutterstock

More precise forest fire warnings improve safety

The rescue authorities, among others, benefit from the enhanced regional precision of forest fire warnings.

The Finnish Meteorological Institute usually gives its first forest fire warnings of the year in early May and the last in early October, at the latest. The warnings are classified using indices calculated by means of a model describing the moisture conditions of the uppermost layer of soil. The input data for the model include precipitation and air temperature.

A new forest fire index with more precise regional data was in test use for the first time in summer 2008. Its local resolution is one kilometre, or a hundred times better than that of the previous system. The new system considers meteorological circumstances in greater detail than before. Thanks to the improved resolution, information such as the accumulated rainfall – which is important for the index – can be utilised with the same accuracy as that of the weather radar.

"Higher resolution is also crucial for the further development of the index. Thanks to higher resolution, information on local circumstances, such as topography, vegetation and soil quality, can be utilised better," says Researcher **Irene Suomi**.

The Finnish Meteorological Institute has been developing the system in a project under the European EU/PREVIEW research programme (PREVention, Information and Early Warning). The other participants in the project are Météo-France and the Joint Research Centre. The goal of the programme is to develop methods and techniques for the prevention, management and aftercare of various natural disasters.

The new forest fire index with more precise regional data was used for the first time in summer 2008.

Jorma Leskelä

The Finnish Meteorological Institute is responsible for weather, marine and climate services important for general safety and for the operations of industry and business. In addition, the Institute provides specialised weather services tailored for various customer groups and subject to charge.

A new warning system

to warn of natural disasters

A system keeping a constant watch on natural disasters and analysing their effects will be set up in Finland.

The purpose of the *Luova* system is to generate up-to-date information on natural disasters, such as storms, floods, volcano eruptions, earthquakes, spreading of hazardous materials, or tidal waves, that might pose a threat to the population of Finland. The national warning centre will be established by expanding the Finnish Meteorological Institute's 24-hour weather warning system to include the monitoring of other natural disasters and extreme phenomena as well. When predetermined criteria are exceeded, the operator consults an expert in that particular field and forwards information to the authorities and to the general public.

The objective of the *Luova* project is to improve the clarity, efficiency and quality of real-time communications on natural disasters and the consequent actions taken by the authorities. The Finnish Meteorological Institute coordinates the project. The other bodies providing specialised information are the Finnish Environment Institute and the Institute of Seismology of the University of Helsinki.

The Luova portal serves as the basis for informing the authorities and also enables public dissemination of information. The information system will be constructed in 2009–2010. The first phase of the system will be taken into use in 2010. Luova is part of the situation picture system maintained by the Prime Minister's Office.

> *"The objective of the Luova project is to improve the clarity, efficiency and quality of real-time communications on natural disasters and the consequent actions taken by the authorities.*

UVI forecasts

globally on the Finnish Meteorological Institute's website

The website service of the Finnish Meteorological Institute provides three-day forecasts for UV radiation everywhere in the world. The service also includes observation data on the UV index in Finland.

The UV index, or UVI, is a single figure indicating the intensity of solar ultraviolet radiation. The need for protection starts when the index reaches 3. The Finnish Meteorological Institute issues a warning about strong radiation when the UV index in Finland is predicted to reach 6.

As recommended by the United Nations, the UV index is used in the same way throughout the world. The highest UV index values measured in Finland, 5–6, can be reached on the southern coast in mid-summer at noon. By the Mediterranean, the UV index in summer is 8–10. Around the equator, the UV index may rise to 15, and may even exceed 20 on high mountains.

"The principal factors affecting the variation in the UV index are the geographical location, the season and the time of the day. Other factors affecting the UV index include cloudiness, the altitude from sea level, and the ozone content in the upper atmosphere. The Meteorological Institute's UVI forecast is made for cloudless weather. The forecast also considers the location and the ozone level," researcher **Anders Lindfors** explains.

The UVI forecast can be accessed on the website www.fmi.fi/uvi. The service is also available in Swedish and English.

Antonin Halas

"The highest UV index values measured in Finland, 5–6, can be reached on the southern coast in mid-summer at noon.

Researcher Anders Lindfors and the instrument used for measuring the UV index in six localities in Finland.

Weather services on the urban scale

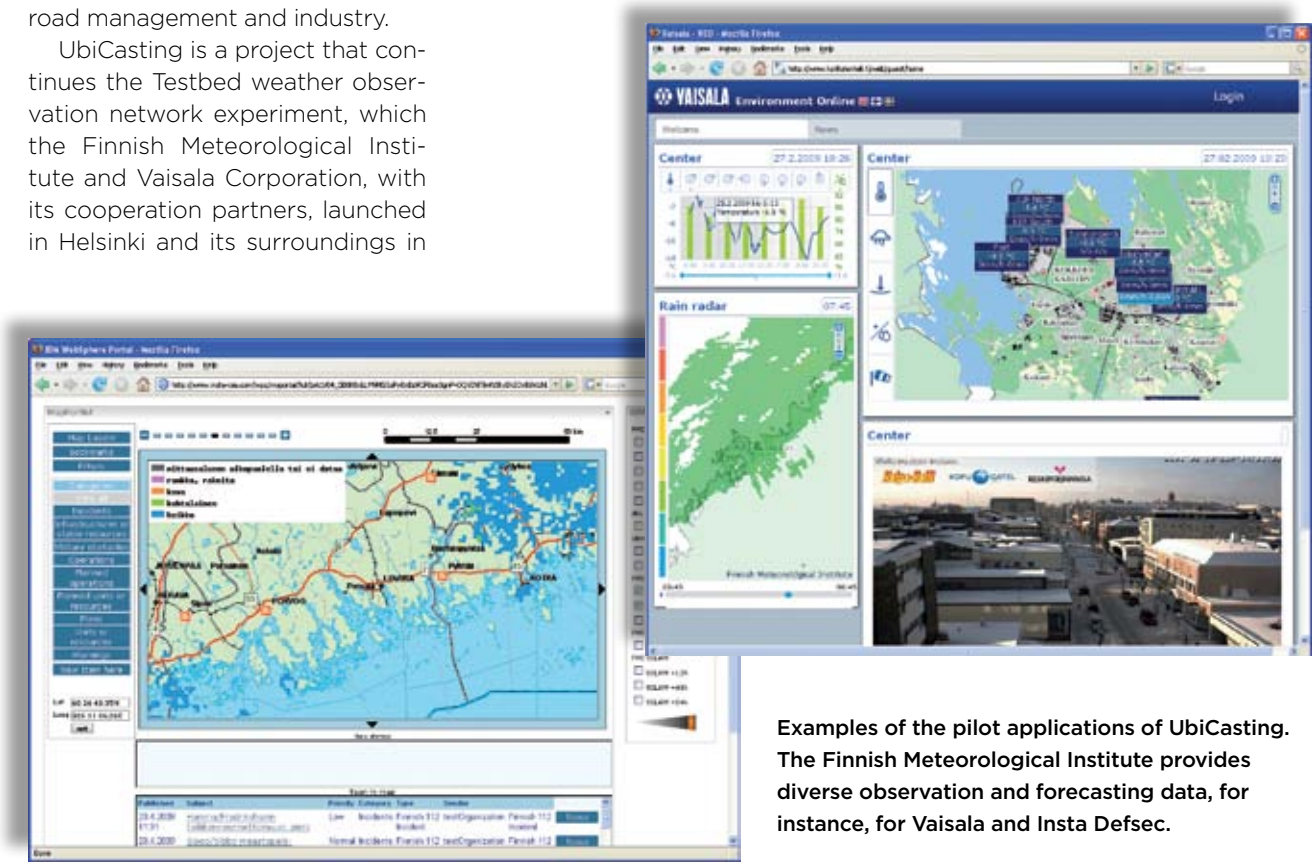
A joint project by researchers of the Finnish Meteorological Institute and companies concentrates on products that give constant, real-time information on small-scale weather phenomena on the urban scale.

The need for ubiquitous weather services rises as society becomes increasingly sensitive to the weather. Coordinated by the Finnish Meteorological Institute and funded by Tekes and businesses, UbiCasting focuses on the development of analysis methods for weather observations and customer applications, and on inter-organisational applications. In addition to atmospheric research, the project serves as a platform for pilot testing various service applications concerning the weather and air quality, in particular to meet the needs of road management and industry.

UbiCasting is a project that continues the Testbed weather observation network experiment, which the Finnish Meteorological Institute and Vaisala Corporation, with its cooperation partners, launched in Helsinki and its surroundings in January 2005. The denser weather observation network constructed earlier is now used as part of new products for end-users. The products serve industry and enterprises, but also the authorities and citizens. Besides making weather observations, the project uses a new model for analysing the weather, and other models for predicting the weather and air quality. The same observation masts and models are tailored according to the individual needs of various actors.

Pilot products for road management and ports

The project has developed a new model for spreading salt on roads, and has implemented a new dispersion model application for monitoring gas emissions during accidents. Both projects improve the safety of citizens. A pilot application carried out in Kokkola focuses on the daily challenges arising from the weather at industrial sites and in the port.



Examples of the pilot applications of UbiCasting. The Finnish Meteorological Institute provides diverse observation and forecasting data, for instance, for Vaisala and Insta Defsec.

Hazardous and harmful weather conditions in 2008

In 2008, the Readiness Service working under the Weather and Safety Centre issued 84 advance warnings of hazardous weather to the rescue authorities and other authorities. No official bulletins needed to be issued.

During 2008, there were 18 stormy days in Finnish sea areas (the average is 23 days). The highest wind speed in sea areas, 28 metres per second, was measured twice towards the end of the year.

According to a study conducted by VTT Technical Research Centre of Finland, weather forecasts bring benefits to society worth over 300 million euros annually. The greatest benefits are reaped in traffic.

Storm on 3 February

A wind blowing between west and southwest gathered speed and became a storm. The average wind speed in sea areas rose to 21–25 metres per second, and stormy gusts were measured in land areas. The worst situation was in Satakunta. In all, about 15,000 households suffered from power cuts.

Gales with snow flurries on 13 February

A storm centre moving eastwards on the Arctic Ocean was followed by very cold gusty winds in Finland. In land areas, the average wind speed was under 10 metres per second, but in gusts the wind speed was over 20 metres per second. In total, 20,000 households were without electricity in Central Finland and in Oulu Province.

Blizzard on 26 March

A strong low pressure system arrived in Finland from the southeast, accompanied by high northeasterly winds and heavy snowfall. In places, over 15 centimetres of snow fell, especially in eastern Finland. Driving conditions became very bad, and at least one person died in traffic accidents. There were delays in both air and train traffic.

On 10 November, a strong wind caused problems to the scaffolding in use at Helsinki Railway Station.

Mikko Rauhala

Downbursts in Savo on 25 and 26 July

A small cluster of thunder squalls developed in eastern Finland late in the evening and at night, felling some trees in Savo. The same cluster continued towards Russia in the early hours of the morning.

Large hail in southern Finland on 1 August

Very strong thunderstorms arose in southern Finland, and hail as much as 4–5 centimetres in diameter hit Uusimaa and Kymenlaakso. The hail damaged plants and dented many cars.

Blizzard on 31 October and 1 November

A low pressure system arrived in Finland from the Baltic countries, bringing mild air and rains to southern Finland. In the Suomenselkä region and in Oulu Province, however, the rain turned to snow, and 30 centimetres of new snow was measured in places. In Oulu Province, heavy snow bent trees onto power lines, which caused power cuts for about 5,000 households.

St. Martin's Day storm on 10 November

Strong winds in southern Finland gained very high speeds. Gusts of

over 30 metres per second were measured in sea areas, and even on land gusts reached about 25 metres per second. The average wind speed measured at Helsinki-Vantaa Airport, 20 metres per second, almost exceeded the threshold of a severe gale. The wind felled many trees and ripped off roofing. Power was cut for 75,000 households.

The worst snowstorm of the year on 23 November

A very deep low pressure arriving from the Black Sea region brought a heavy snowstorm to almost all of Finland. On average, 10–20 centimetres of snow fell, even more in some places on the southern coast. On the northern side of the storm centre, a strong wind blowing from north to northeast felled trees and meant power outages for 50,000–60,000 households in southern and eastern parts of the country. In the western sea areas, the highest winds measured were 25–28 metres per second (in gusts over 30 metres per second), and stormy gusts also occurred in land areas. Trains were delayed, driving conditions were very bad, and flights scheduled to land at Helsinki-Vantaa Airport were redirected to other airports.

New Year's storm on 31 December

A small but strong low pressure system deepened and passed over Lapland quickly to the east. The average wind speed in the northern parts of the Gulf of Bothnia was 28 metres per second, and high winds were also measured in land areas. Gusts at sea were exceeded 30 metres per second and on land 20–25 metres per second. Fireworks shows were cancelled in many municipalities in Oulu Province. In addition, the wind ripped off roofing, cut the power for as many as 50,000 households in eastern and northern Finland, and brought train traffic to a halt on the Savo line and south of the City of Oulu.


Plugi

The year 2008 was warm and rainy

The mean temperature in Finland in 2008 was higher than the average. Local records were broken for both temperatures and precipitation.

For all of Finland, 2008 was the sixth warmest year in the measurement history of the Finnish Meteorological Institute. The difference from the long-term average was over 2 degrees in southern Finland and between 1 and 2 degrees in the central and northern parts of the country.

The Helsinki-Kaisaniemi observation station of the Finnish Meteorological Institute measured the highest annual mean temperature, 7.6° C, in all of its history extending to 1829. In Hanko, too, the mean temperature for the year, 7.9° C, was the highest ever measured since 1868, when the meteorological station was established. Another rare event was also recorded in Kaisaniemi in 2008: for the first time in the station's history, the mean temperature for every month of the year was above zero.

Record-mild winter 2007–2008

The number of winter days, or days when the daily mean temperature is below zero, was clearly lower than the average. On the southwestern and southern coast, thermal winter (the daily mean temperature permanently under zero) did not last for more than a few days in late winter. In southern and central parts of the country, the snow cover was thinner than the average throughout the winter; the southernmost regions did not get a proper permanent snow cover at all.

→


Eija Vallinheimo


Joonas Korpilaakso

→

"The high annual temperatures for southern and southwestern Finland are largely explained by the very mild first months of 2008. Air currents came from the southwest, and there was hardly any ice on the Baltic Sea or on the Gulf of Finland or the central Gulf of Bothnia," meteorologist **Asko Hutila** explains.

"The mean temperature of winter 2007–2008 was about five degrees above the long-term average. Four degrees of this is explained by natural variation and one degree by global warming. Winters like this will become more common as climate change proceeds. Cold winters with thick snow will be rarer but will still occur occasionally despite climate change. The main reasons for these great natural variations are Finland's location in the north as well as its location on the edge of a large continent."

Not a hot summer

Spring 2008 was slightly warmer than average, while summer was cooler and rainier than usually. In many areas in eastern and northern Finland and in the archipelago, the temperature did not exceed 25°C even once all summer. This is rare according to statistics kept by the Finnish Meteorological Institute.

"Cold winters with thick snow will be rarer but will still occur occasionally despite climate change.

The tenth warmest autumn in 2008

In almost all of Finland, autumn 2008 was among the ten warmest autumns during the history of measurements. December was also warmer than the average. On the southern and southwestern coast, thermal winter did not start until the very end of the year.

The autumn was also unusually rainy in some places. The precipitation measured for the whole year was higher than the average for the whole country, and annual precipitation records were broken in various localities throughout Finland. The Finnish Meteorological Institute's researchers estimate that climate change will also mean increased rainfall in the future. ■


Eija Vallinheimo

Economics must be considered when solving environmental problems

Nicholas Stern's report on the global economic impacts of climate change awakened many people to the economic risks of climate change. How to combine economics and environmental problems is the topic of a joint training programme on environmental economics set up by the Finnish research institutes.

Environmental economics is a subfield of economics that studies how environmental protection and economics can be combined in a sensible way. The Finnish Meteorological Institute is involved in a cooperation project where personnel from the Meteorological Institute, the Finnish Environment Institute, the Finnish Forest Research Institute, and the Finnish Game and Fisheries Research Institute study environmental economics for 2.5 years alongside their own work.

"After the course, the participants will find it easier to see economic dimensions in their own research work. At the same time, they learn the basics of accounting and learn to assess, for instance, the benefits and costs of various actions," says **Markku Ollikainen**, Professor in Environmental Economics at the University of Helsinki, who is leading the course.

Knowledge of environmental economics is also needed when studying the impacts of climate change and the action models to apply. "The economy is a central background factor behind environmental problems but, on the other hand, it also plays an important role for solving problems," Ollikainen points out.

New perspectives on research at the Finnish Meteorological Institute

Climate change is not the only area where reviews on economic impacts can be utilised. For instance, reviews can be useful when assessing the impacts of meteorological phenomena and when developing various warning systems," says Senior Researcher **Heikki Tuomenvirta**.

"The training programme combines environmental science and economics in a way that opens new perspectives for both research and other projects. And what's best, after the course we'll have a better understanding of the links between environmental science and economics," says Controller **Janna Karasjärvi**.

Antonin Halas

Besides their work, Researcher Juha A. Karhu and Controller Janna Karasjärvi study environmental economics.

> *"The economy is a central background factor behind environmental problems.*

Meteorological institutes produce

environmental and security services for GMES

Mikko Strahlendorff of the Finnish Meteorological Institute works as an advisor at the European Commission's GMES Bureau in Brussels.

GMES (Global Monitoring for Environment and Security) was founded by the European Commission and the European Space Agency (ESA) in 1998 to bring together information pertaining to the environment and environmental threats, thereby helping decision-makers to create a more comprehensible overall picture of the state of the environment and consequent development needs.

Mikko Strahlendorff of the Finnish Meteorological Institute has been working at the GMES Bureau since 2007. Among other things, he works to clarify the role of European weather services in fulfilling the mission of the European Commission. His main duty is to manage issues pertaining to the GMES marine and atmospheric services and to promote the generation of a climate service concept. At practical level, he helps determine, for instance, which information services in ground-based networks need to be shared more and developed, both in Europe and globally, to meet the objectives of GMES.

The Finnish Meteorological Institute has a strong representation in international organisations. For instance, the Institute is represented in every technical commission of the World Meteorological Organization. The Institute also has several cooperation projects with its sister institutions, e.g. in Estonia, Russia, Romania and Croatia, and during the past 20 years has carried out development and consultancy projects in nearly 80 countries.

"European meteorological institutes already produce much of the current services provided by GMES. In addition, they constantly produce new operational services; thus, their participation in GMES projects has enabled the development of new services, for instance, for the rescue authorities," Mikko Strahlendorff explains.

"However, meteorological institutes do not yet play an optimal role in the provision of GMES services. High-level competence must be given a role that corresponds to the competence. Small countries must also be able to bring out their strengths in the large context."

The FMI as a provider of marine services to GMES

The marine safety services of the Finnish Meteorological Institute play a major role in the GMES marine services. The MyOcean project provides marine model services globally for seafaring: on the large scale for oceans and regionally for European sea areas, the Arctic Ocean, the Baltic Sea, the Mediterranean, the Black Sea, the North Sea, and various parts of the Atlantic. MyOcean is the largest GMES pilot project; it was launched in Toulouse in April 2009.

GMES launched the MyOcean project in France in April 2009. Mikko Strahlendorff is the second on the right.


Antonin Halas

Research Professor Sergej Zilitinkevich appreciates the standard of Finnish atmospheric research and values cooperation between institutes.

A major research grant

for studying the planetary boundary layer

The European Research Council (ERC) has awarded Research Professor Sergej Zilitinkevich of the Finnish Meteorological Institute an Advanced Grant of two million euros.

The goal of the research project of **Sergej Zilitinkevich** is to determine how the planetary boundary layer, or the lowest part of the atmosphere (0.1–1.5 kilometres), can be described better by developing the physical depiction of turbulent processes. Turbulence makes the boundary layer different from all other atmospheric layers. The roughness of various surfaces and thermal conditions have a direct effect on air currents. In fact, application of the laws of physics in atmospheric modelling is a great challenge.

"Complex physics now plays a more important role in modelling because the resolution of models has improved along with more powerful computers. Now the time is ripe for research of this type," Professor **Sergej Zilitinkevich** explains.

Better understanding of physics in the planetary boundary layer helps improve the operation of atmospheric models. In practice, the results of the research can be applied in numerical weather forecasting and in climate and air quality models.

Cutting-edge research in Finland

As holder of the Marie Curie Chair, Sergej Zilitinkevich has worked as a Professor at both the University of Helsinki and the Finnish Meteorological Institute since 2004. He emphasises the importance of cooperation between these two bodies. "Finland has solid expertise in research on the planetary boundary layer; in particular, aerosol research is of the highest standard," he says.

This was one of the reasons why he decided to continue his career in Finland. Sergej Zilitinkevich is originally from St. Petersburg. He credits his long and successful career to the fact the he has been able to study and work with the best and most renowned experts in the field. He left Russia in 1990 and worked first in Denmark before taking up a professorship at Max Planck Institute in Germany. Before coming to Finland, he worked for six years at the University of Uppsala in Sweden. The ERC awarded its first Advanced Grants in 2008. The maximum grant sum is EUR 3.5 million. In total 2,167 proposals were submitted.

At present, the Finnish Meteorological Institute has four research professors from abroad. In all, people from about 15 countries work at the Institute.

Antonin Halas

Tuija Pulkkinen elected President of EGU

Tuija Pulkkinen of the Finnish Meteorological Institute has been elected President of the European Geosciences Union for the period 2008–2011. EGU is a scientific organisation covering a wide spectrum of geosciences, from geology to atmospheric and space sciences. EGU publishes some of the most important scientific journals in its field, convenes representatives of various disciplines for an annual General Assembly, and disseminates information on events and research findings in its field. The Union's operations are managed by a Council consisting of the Presidents of all 21 Divisions. The annual General Assembly gathers together about 8,000 participants from all over the world.

"The importance of geosciences in society is constantly on the rise. The scientific work done within EGU can influence many topical issues, such as energy solutions or the impact of climate change," Tuija Pulkkinen says. For the past four years she served as President of the EGU Division of Solar-Terrestrial Sciences and in that capacity has also been a Council member. At the Finnish Meteorological Institute, Tuija Pulkkinen leads the Earth Observation Division. She is the first Finnish President of EGU.

Minna Palmroth at the forefront of Europe's young researchers

Minna Palmroth, Academy Research Fellow working at the Finnish Meteorological Institute, has risen to the elite of Europe's young researchers. Funded by two major grants, she and her group study near space and its dynamics.

In 2008, **Minna Palmroth** was appointed an Academy Research Fellow of the Academy of Finland and was awarded the Starting Independent Researcher Grant by the European Research Council. Thanks to total funding of about EUR 1.2 million, Minna Palmroth's group of four researchers can concentrate on their research for an unusually long time in Finland – about five years.

The main purpose of the funding included in the 7th EU Research Framework Programme of the European Research Council is to strengthen European scientific research and to ensure continued scientific leadership in Europe. Nearly 10,000 applications for the Starting Grant were received from all fields of science; 300 of them received funding.

The research done by Minna Palmroth's group is divided into two sectors. The project studies energy transfer between space plasmas, using both satellite and ground-based observations. The energy transmitted from solar wind to the Earth's near space is the driving force for all space weather phenomena in the Earth's plasma environment, e.g. auroras. The project is also developing a new computer simulation program that can generate a better and increasingly accurate model of circumstances in space. The goal of the new model is to produce a more accurate picture of space weather in areas near the Earth. It can form a basis for future space weather forecasts that are used, for instance, to predict conditions in the environment of telecommunication satellites.

Nanni Akkola

The Advisory Board of the Finnish Meteorological Institute.

The Advisory Board of the Finnish Meteorological Institute

Following the amendment to the Decree on the Finnish Meteorological Institute that entered into force at the start of 2009, the Institute's Board of Directors has been replaced by an Advisory Board. The Advisory Board's task is to assess the Institute's research and development activities in general and to support strategic planning. In addition, the Advisory Board promotes cooperation between the Institute and its stakeholders. The Ministry of Transport and Communications appoints the Advisory Board for a term of three years. The Board comprises the Institute's Director General and at most 12 other members, of whom one represents, and is selected by, the Institute's personnel.

Advisory Board, 15 January 2009–14 January 2012

- Paula Kankaanpää, Director, Arctic Centre, Chair
- Pekka Plathan, Director-General, Ministry of Transport and Communications, Vice Chair
- Eeva Furman, Research Manager, Finnish Environment Institute
- Kjell Forsén, President & CEO, Vaisala
- Sirkka Haunia, Principal Negotiator, Ministry of the Environment
- Raimo Heino, Graphic Designer, Finnish Meteorological Institute (personnel representative)
- Kai Kaatra, Head of Unit, Water Resources Management, Ministry of Agriculture and Forestry
- Sakari Karjalainen, Director General, Ministry of Education
- Ritva Koukku-Ronde, Director General, Ministry for Foreign Affairs
- Markku Kulmala, Academy Professor, University of Helsinki
- Seija Paasonen, Senior Meteorologist, Finnish Broadcasting Company
- Petteri Taalas, Director General, Finnish Meteorological Institute
- Kari Takanen, Commodore, Defence Command, Finnish Defence Forces

Marine services and marine research integrated into the FMI

As of 1 January 2009, the Finnish Meteorological Institute has been responsible for marine safety services, physical marine research, marine climate research, the logistics of the Finnish Antarctic Programme, and for the marine technological services of the Aranda research vessel.

The Finnish Institute of Marine Research was dismantled at the start of 2009 and its marine services have been incorporated into the weather services of the Finnish Meteorological Institute. Monitoring of sea-level observations began on 1 April at the FMI Weather Service, which will also assume responsibility for the monitoring of sea-level prognoses, wave forecasts and ice services in autumn 2009.

Research Professor Kimmo Kahma was appointed Head of the Marine Research unit, which began operations at the Finnish Meteorological Institute at the start of the year, for the term 1 March 2009–31 December 2010. The unit has three groups: Ice Research and Ice Service; Waves and Sea Level; and Hydrodynamics of the Sea.

VISION

The Finnish Meteorological Institute – cutting-edge expertise in European atmospheric know-how.

VALUES

Expertise
Courage
Fair play

Mission statement

The Finnish Meteorological Institute produces high-quality observational data and research findings on the atmosphere and on seas. The Institute uses its expertise effectively to provide services that promote public safety and enhance well-being among people and in the environment.

The Finnish Meteorological Institute

- observes the physical state, chemical composition and electromagnetic phenomena of the atmosphere
- observes the physical state of seas, especially that of the Baltic Sea
- produces information and services about the past, present and future states of the atmosphere and seas
- conducts high-standard research in the fields of meteorology, marine sciences, air quality, space physics, earth observation and geomagnetism
- carries out competitive commercial activities, based on expert services, both in Finland and abroad
- takes an active part in national and international cooperation
- actively disseminates information about matters associated with the atmosphere, seas and space
- foresees changes and responds quickly to changes in the environment and to changing expectations.

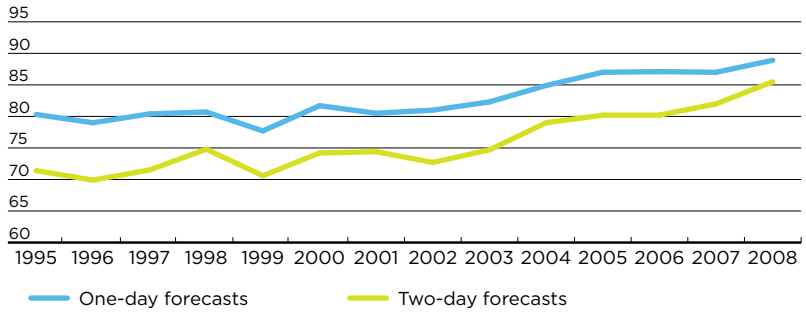
Management Group of the Finnish Meteorological Institute 1.1.2009–31.12.2009

- Petteri Taalas, Director General
- Yrjö Viisanen, Director, Research and Development
- Juhani Damski, Director, Weather and Safety
- Marko Viljanen, Director, Administration
- Kimmo Kahma, Head of Unit, Marine Research
- Tarja Riihisaari, Head of Unit, Development of Services
- Markku Seppänen, Personnel representative
- Eeva-Kaisa Heikura, Communications Manager
- Joanna Saarinen, Management Group Secretary

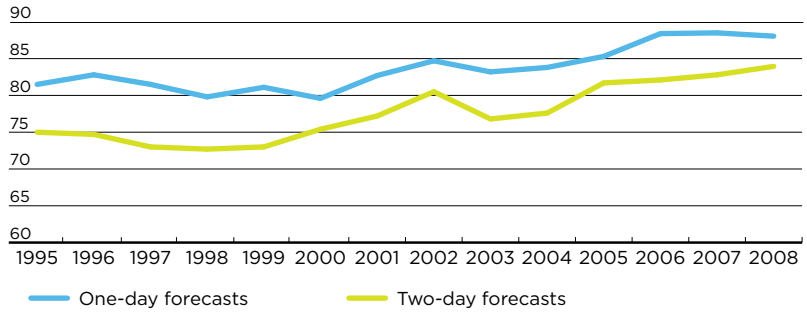
DIRECTOR GENERAL AND DIRECTOR GENERAL'S OFFICE Communications and International Affairs	
WEATHER AND SAFETY	**RESEARCH AND DEVELOPMENT**
Weather and Safety Centre	Climate Change
Commercial Services	Air Quality
Development of Services	Meteorology
ICT Management Services	Marine Research
Observation Services	Earth Observation
	Arctic Research
	Kuopio Unit
	Consulting Services
ADMINISTRATION	

Result Indicators

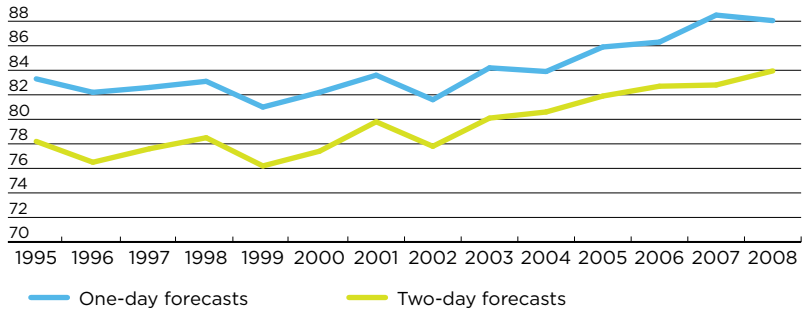
Accuracy of temperature forecasts



Accuracy of rainfall forecasts



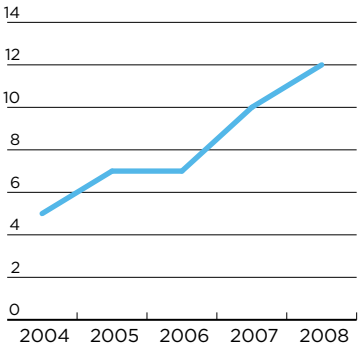
Warnings for high wind



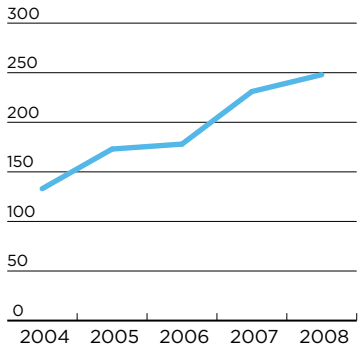
Availability of systems

	2008	2007	2006	2005	2004
Satellite systems	98.6	98.5	98.1	98.3	98.0
Information systems	99.9	99.8	99.6	99.9	99.9
Availability of radar systems (mean), %	98.5	98.2	99.3	99.3	99.4
Availability of satellite systems (mean), %	98.6	98.5	98.1	98.3	98.0

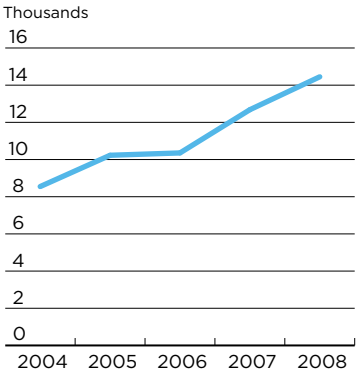
Doctoral dissertations



Publications subject to international peer review



Scientific publishing index



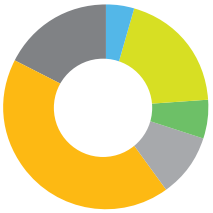
Personnel

Job Satisfaction 2008

Person Years (566)

Weather and Safety	270
Research and Development	254
Administration and Director General's Office	42

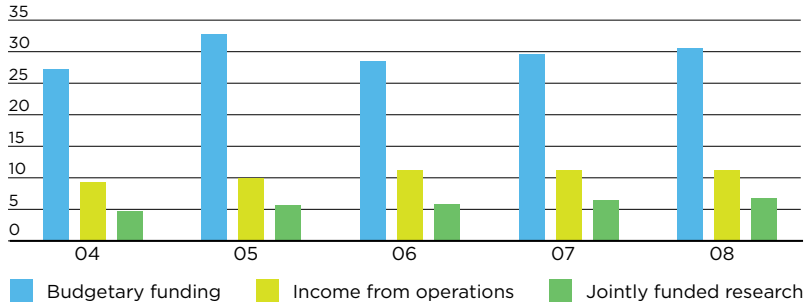
Breakdown of the Personnel's Education %



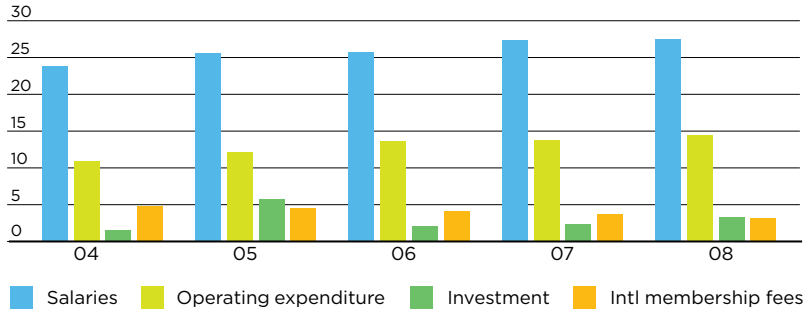
General Education	4.5
Secondary Level	19.6
Lowest Post-Secondary	6
Lowest Tertiary	10
Higher Tertiary	42.5
Doctoral and Licentiate's Degree	17.3

Finances

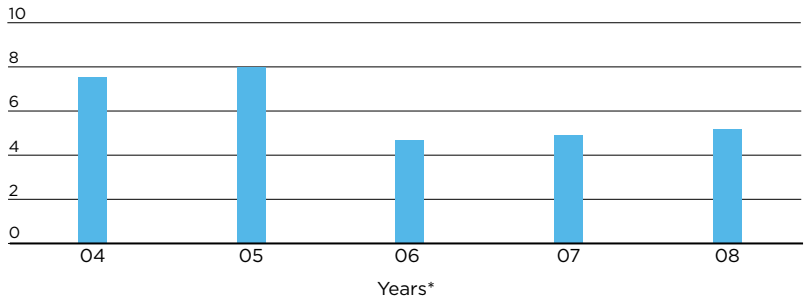
Financial Trends 2004–2008 (€ Million)



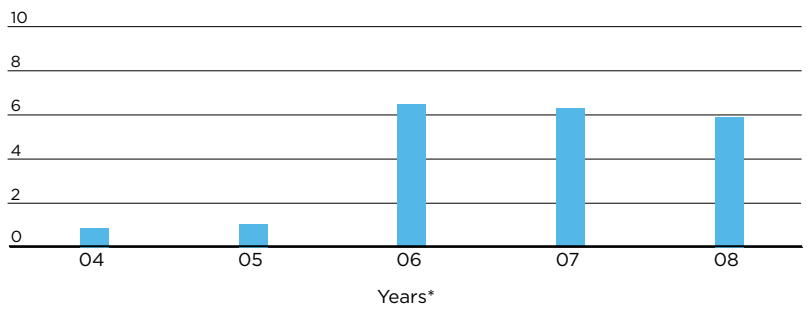
Expenditure Trends 2004–2008 (€ Million)



Trends in Income from Commercial Operations



Trends in Income from Operations under Public Law



* In 2006, civil aviation services were reorganised under public law.

Funding 2008

Total 48.5 € Million

Budgetary funding	30.6
Income from operations	11.2
Jointly funded research	6.7

Expenditure 2008

Total 48.5 € Million

Salaries	27.5
Operating expenditure	14.5
Investment	3.3
Intl membership fees	3.1

Income from Operations 2008

Total 11.2 € Million

Income from commercial operations	5.2
Income from operations under public law	5.9
Other income	0.1

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